REAL-TIME ENVIRONMENTAL INFORMATION NETWORK AND ANALYSIS SYSTEM (REINAS)

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LONG-TERM GOALS:

The long term goals of the NPS portion of this project, which is joint with UCSC, are to develop a mesoscale coastal analysis system for use in diagnosing and predicting coastal circulations in a topographically complex coastal region and to provide guidance to UCSC for the development of data collection, data management, and visualization tools for mesoscale meteorological problems.

OBJECTIVES:

The specific scientific objectives of this project are to develop a coastal mesoscale data assimilation system using multiquadric interpolation and the Navy's NORAPS and NCAR/Penn State MM5 model, diagnose the sensitivity of the diurnally varying winds in the Monterey Bay to synoptic-scale influences using the data assimilation system and other REINAS tools, and to assess the role of the complex coastal topography in modifying the Monterey Bay sea breeze.

APPROACH:

The primary approach used in this study is to document the structure of the Monterey Bay sea-breeze using a surface meteorological mesoscale observing network and wind profilers either continuously deployed or deployed for a specific period of investigation (summer 1994). These observing systems are used to develop the REINAS computer software at UCSC as well as to conduct scientific studies. The mesonet is being used to feed the REINAS data collection and data base system in real-time. These observations are also being used to make objective analyses of the meteorological conditions over the Monterey Bay on a routine basis using multiquadric interpolation techniques. These analyses are used to examine the diurnal and spatial variations in the winds for the region. In addition, these observations are being used to design and build a mesoscale modeling and data assimilation system for the region using NORAPS and MM5 with multiquadric interpolation. These model simulations are used to assess related aspects of the sea-breeze circulation.

WORK COMPLETED:

A variety of tasks have been completed during FY97 that further the progress on developing REINAS

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into a quasi-operational system and utilizing it for scientific studies. The data base breadth was extended by adding the California Irrigation Management Service (CIMIS) stations to REINAS. These are presently loaded in retrospective mode through a manual process but work is underway to automate this process as well as make it work in real-time. The addition of these stations puts the number of surface observing sites cataloged in REINAS near 200. Work continues through the collaborations in the Bay Area Mesonet Initiative (BAMI) to expand the sites going into REINAS. Both the Monterey Bay and San Francisco Bay area air pollution agencies are now feeding data into the REINAS system. Although in the beginning stages, NEXRAD data is now being loaded into the REINAS system and NPS has begun to examine this data and develop software to use it in the local data assimilation efforts.

Numerous tasks related to the use of the local observations in REINAS have been completed in FY97 as well. The three dimensional multiquadric interpolation-based data assimilation system is running routinely to perform local mesonet analyses and is used to start the NPS MM5 real-time model runs for California. The local wind analysis is routinely placed on the web as are the MM5 model forecasts. Additional datasets are being examined for inclusion into this system and some rudimentary gross error checking algorithms were added to improve performance. The local mesoscale analyses have been used in studies of the Monterey Bay sea breeze, which are nearly complete and a paper is in progress describing these results. In addition, these analyses have been supplied to the Monterey Bay Unified Air Pollution Control District for their pollution transport studies.

RESULTS:

The primary results for the past year reflect a new capability to analyze and understand mesoscale circulations within the Monterey Bay. The three dimensional multiquadric interpolation approach to data assimilation demonstrates the need to analyze the surface observations in complex topography in three dimensions. Previous analysis using two dimensional analysis approaches produced unrealistic thermal and wind analyses in the complex mesoscale topography. The three dimensional approach correctly analyzes the horizontal and vertical thermal structure in the boundary layer with observations distributed over the topography in the domain. These results show promise to allow surface observations to have a more substantial impact on model forecasts, at least in the short ranges (12-24 hours). The extension of the three dimensional analysis to routine application using the REINAS data in the past year has also highlighted the sensitivity of the analyses to data quality and distribution. Mesoscale quality control has posed significant problems for our routine application of the data assimilation. The addition of this aspect to the assimilation software is a major thrust at the present time.

The other important results during the past year have been an increased understanding of the Monterey Bay sea breeze and its relationship to the synoptic-scale flow. A thorough analysis of the June 1996 time period has shown that identifiable differences in the horizontal and vertical structure of the circulation over the Monterey Bay occur under different synoptic regimes. Last year it was reported that differences for onshore and offshore directed synoptic-scale flows were seem in the sea breeze intensity and tendency for horizontal circulations within the Monterey Bay region. These difference were strongly related to the depth of the marine layer and its impact on the surface heating. Horizontal differences have also been found which relate to the interaction of the complex topography and the surface heating. These results are being written up in a paper. Although the thermally forced circulations are easily understood from a theoretical standpoint, the results of this study suggest that the interaction of many factors is critical in understanding the detailed flows in a complex coastal environment.

IMPACTS:

The impact of this study is that it contributes to a more thorough understanding of mesoscale coastal processes that are of interest to the Navy. The most significant aspect is that these results begin to help characterize the nature of coastal flows in complex coastal topography that future generation operational mesoscale models such as COAMPS will try to predict. In addition, our research on the data assimilation using the multiquadric technique is significant in that it may be the most appropriate approach for small shipboard modeling systems, where observations are few and data density is very discontinuous over the model domain.

TRANSITIONS:

Although no transitions have occurred with this work as of yet, efforts are underway to supply the mesoscale analysis software to the NWS Monterey Office for use in operational forecasting.

REFERENCES:

http://www.met.nps.navy.mil/~nuss/ctd_exp/latest_mry.gif

http://www.met/nps.navy.mil/~dmiller/MM5/